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## MIGRATIONS OF BIRDS.

BY GRANT ALLEN.

IN Mr. Darwin's unpublished fragments on instinct, lately printed by Mr. Romanes as an appendix to his admirable work on "Mental Evolution in Animals," there occurs a passage of some interest, which has given me food for thought on many occasions since I first read it, and which may serve as the text on which to hang a few reflections about the possible *modus operandi* of migration in birds. It runs as follows:—"How a small and tender bird, coming from Africa or Spain, after traversing the sea, finds the very same hedgerow in the middle of England where it made its nest last season, is truly marvellous."

Now, I suppose we may accept the fact as stated, on Mr. Darwin's authority; for he was not given to use mere rhetorical phrases in this way without having first satisfied himself that they accurately represented observed truths; and we may therefore proceed to consider how far the phenomenon in question is really explicable on familiar lines. It seemed to me, when I first read this passage, that such a geographical instinct as appears at first sight to be implied in the statement was almost inconceivable in a small bird; and its very inconceivability set me thinking by what mechanism the bird could possibly manage thus to wing its way accurately over trackless seas and barrier mountains to a single well-remembered English hedgerow. The more one thought about it, however, the more clear did it become, that this case was one where that famous "scientific use of the imagination," about which Professor Tyndall has so often discoursed to us, might find a fair field for its proper application. Let us just try to throw ourselves for a moment into the mental altitude of the bird—endue ourselves, as it were, in the avian personality—and see how far the apparent difficulties vanish or minimise themselves when we fairly face the actual position of the keen-eyed migrating creatures themselves.

The bird passes his whole existence in taking what we significantly call "a bird's-eye view" of things in general. Living perpetually on the wing, now high in air, now low by the fields, his mental picture of the country in which he dwells must always be far more map-like and wide-spread than our own, besides having much more variety of perspective and relative position. For us, the view is constantly bounded all round by hills and downs, trees and hedges, houses and walls. To get from one point to another, we do not usually go in a straight line, "as the crow flies," but wind in and out, among lanes and foot-paths, with our ultimate object usually out of sight, and finding our way by a long series of more or less perfectly remembered twists and turning-points. But the bird has no need to burden his memory with such a vast stock of clues, as mere means to his ultimate end; he need only rise high enough in the air, and he sees at once the actual spot for which he is making, and sails down towards it immediately in a straight line.

Again, we have all observed how much better a notion we have of the geography and topography of a country when we have ascended its chief hills or mountain-tops. People who walk much on the tops of downs in England get to have a very distinct picture of all the surrounding fields, plains, valleys, hills, spurs, watercourses, towns, and villages in their true relations to one another. They see the land "spread out like a map before them," and they learn to recognise the neighbouring landmarks from several distinct points of view. As a rule, if we live on the plain (as most of us unfortunately do) we know only one front or profile of each particular hill or boundary-line of the landscape; but if we walk about much on the hill-tops, we get to know the other alternative aspects of the same heights, and to recognise the various elements from whatever side. A stroll of ten miles along the summit of the North Downs, for example, from Dorking to Guildford, will give one a whole series of panoramic views over the Weald, the Thames Valley, and the Hampshire Hills, from the South Downs to the Chilterns in one direction, and from Hind Head in Hants, to Crowborough Beacon in Kent, in the other. The greater part of six counties, with all their salient points variously grouped in different perspectives, is thus embraced in the prospect from what would be (for a bird) a single morning's short flight.

Now, while we human beings can only thus rise to the height of a few hundred (or at least a few thousand) feet, at rare intervals, under exceptional circumstances (where hills or mountains happen to exist), a bird can so rise at every point, and can look down upon the country-side, not only from the hill-tops, but also over every part of the plains or valleys. Its mental picture of the surroundings of its own nesting-place must therefore be a very wide and generalised one; a little comparable, perhaps, to the mental picture which a sailor has of the path up the English Channel, or the mouth of the Thames. It conceives of its home, no doubt, as lying about the centre of such and such a saucer-shaped hollow, surrounded by such and such a shifting combination of girdling hills. Given the Thames Valley, let us say, as seen from the North Downs, with the Chilterns in the distance, it knows that its nest lies to the west of the great smoke which overhangs London, and to the east of the long blue line which marks the rolling uplands of Salisbury Plain. In order to reach it, it need not go along winding roads or between high hedges; it soars on the open in the general direction where the nest lies, and at each stroke of its wings it remembers more and more of the minor landmarks which aid it in discovering the exact spot it is seeking in the great hollow spread out in wide array below.

Now, let us put the case of a bird which nested last year in England—at Bagley Wood, near Oxford, for example—and let us suppose it has wintered in Africa, and is desirous of returning in spring to its old familiar summer quarters. The first part of the journey it will doubtless make with all the other English migrants of its own kind, either *viâ* Sardinia, Corsica, and France, or *viâ* Gibraltar and the Spanish

Peninsula. With these earlier steps we are not here concerned; for our question is not how the bird finds its way back to England at all (that problem has been already plausibly solved by Dr. Weismann), but how it finds its way back to its own particular Bagley copses. The general body of migrants, then, reaches the neighbourhood of Boulogne or Dieppe, let us say, by following its previously-remembered path. Now, from Boulogne even human eyes, supported by human legs on top of the Napoleon column, can see the English coast from the South Foreland to Beachy Head; and from Dieppe a bird poised high in air ought to be able equally well to see it from near Brighton to Dungeness. Even if it did not, however, in the latter case, there are two ways in which it might still accurately guide itself across the Channel. In the first place, if it remembered its course southward last year (aided by the general consent of its fellows) it would know that it flew in a certain direction as regarded certain points on the French coast by reversing that direction—in other words, by steering due north, at right angles to the line of cliffs, it would make or sight the English coast. (It wouldn't matter much even if its course was three or four points of the compass wrong either way, for in any case it would at last sight land in about the required direction.) But in the second place, we know now that from great heights in the air, the sea is to some extent transparent (as aëronauts have told us), and its banks and deep pools can be seen through the water, or, at least, discriminated from one another by varying colour and other marks. It is not so very difficult, therefore, to see how a bird can fly across arms of the sea, especially shallow ones; and it is known that their course generally follows the ridge of shallowest soundings in each instance.

Well, let us suppose our bird chooses the Boulogne route. Then, strange as it sounds at first sight, I believe three very simple landmarks would suffice to land him at Bagley Wood. For, from Boulogne, he could distinctly see Beachy Head, easily recognisable as being the tallest white cliff on the whole south coast, this side of Dover. For Beachy Head he and a portion of his fellows steer direct, then; and when they are above it, at, perhaps, 150 feet elevation in the air, they could once more dimly descry the North Downs, with St. Martha's Down, near Guildford, for their goal, well marked as they approached it by its high-perched chapel tower. Hither, accordingly, one detachment of the main body might make—the Midland counties contingent—while others struck off for Crowborough, Hind Head, Box Hill, or other points, whose general lie could be readily discerned from their coign of vantage, though, of course, the exact summits would not be clearly made out till they neared them somewhat more closely. From St. Martha's, even the human eye can see Nettlebed, in Oxfordshire; and once at Nettlebed, our bird would be at his own door, so to speak; for he would be looking down into the very basin with every feature of which he must be familiar from a whole summer's long experience. When one reflects that for a bird, with its free power of flight, these few landmarks between Boulogne and Bagley Wood must be hardly more difficult or wider apart in consciousness than are three successive headlands to a sailor, it is not so mysterious after all, perhaps, that it should find its way straight from the one point to the other without serious mishap. It ought also to be borne in mind that at least some birds (for example, vultures) are known to possess very keen powers of sight; and there can be little doubt that most of them surpass in this respect the ordinary human vision.

At the same time, I don't wish to suggest in any way that this little rough sketch of an explanation touches the central problem of migration at all. I offer it only as a partial elucidation of a single episode or incident in the main theme. Whether there exists a migratory instinct at all has been lately doubted by Mr. Wallace; and he may possibly be quite right in supposing that birds travel in a good many directions, but that only those which travel towards the south and towards the land ever survive. Still, if it does sometimes really happen that birds return year after year (as has frequently been reported) to their accustomed nest, that fact in itself calls for explanation; and it seems to me that a sufficient realisation in one's own mind of the ordinary visual altitude of birds enables us largely to get over the obvious difficulty, and to see that the apparent miracle may be really explicable on just the same principles as those by which we explain our own sailing along a known shore with a few easily remembered and conspicuous sea-marks.

## ASTRONOMICAL COLLISIONS.*

By Prof. C. A. Young, Princeton, N.J.

(*Continued from page* 389, *Vol. IV.*)

If ever two great worlds do really meet in this way, it is possible to predict some of the consequences. To use the technical language of science, "their energy of molar motion will be converted into various forms of molecular and potential energy;" which, translated into the vernacular, means that there will be evolution of heat and light, while at the same time the solids present will be wholly or in part liquefied, the liquids vaporized, and the vapours and gases rarefied and expanded. The intensity of the action will depend, of course, mainly upon the mass and swiftness of the colliding bodies; but an easy calculation shows that if our earth were ever to meet another globe like herself and moving with the same velocity, heat enough would be generated by the shock to transform them both into a huge ball of vapour; unless, indeed, the central core of the earth is much colder and more refractory than usually supposed. At any rate, the quantity of heat developed would be sufficient to melt, boil, and completely vaporise a mass of ice fully 160 times that of both the colliding worlds—an ice planet 97,000 miles in diameter.

If, however, the impinging masses were, to begin with, mainly gaseous (as the sun seems to be), the effect might be curiously different. Heat would, of course, be generated, just as in the case of solid bodies; but, as a consequence, apparently most paradoxical, the resulting nebula might actually be cooler than either of the bodies before the encounter; of course, it would be immensely expanded in volume. Just as a gaseous mass, contracting under its own gravity from loss of heat by radiation at its surface, continually rises in temperature, so a similar mass, expanding against its own gravity from accession of heat within, may fall in temperature—nay, must fall, if the body is composed of "perfect" gas. Of course, immediately after the collision, and before the ultimate expansion of bulk was attained, the temperature and brilliance of the mass would be for a time vastly increased, but the final result would be as stated.

In a preceding paragraph it was said that we have not on the astronomical records a single certain instance of any collision between bodies of considerable size. But there have been several cases of a most remarkable phenomenon, which perhaps may owe its explanation to such encounters. Stars, never before visible, or else known only as faint and

* From the *North American Review*.

minute, have suddenly blazed out, shining sometimes with the brilliance of Sirius, or even Venus, and afterwards faded away to their original insignificance. Such was the famous star of 1572, so carefully observed by Tycho Brahe. As recently as 1866, and again in 1876, similar things have happened, though these later stars were less conspicuous. The star of 1876 (in the constellation of Cygnus) had long been known and catalogued as a telescopic star of the ninth magnitude, with nothing to distinguish it from any of the common herd. On Nov. 24 it suddenly shone out as bright as the pole-star. Schmidt, of Athens, who discovered it, had been observing that very region of the sky only four days before, and no such object was then visible. The intervening days were cloudy, so that we cannot tell precisely the hour when it first blazed up, but evidently its increase of brightness must have been extremely rapid. Immediately after Schmidt's observation it began to fade, but it was two weeks before it fell below the sixth magnitude and became invisible to the naked eye, and it was more than a year before it resumed its original faintness. Its whole course was carefully watched with the spectroscope. At first, and for some months, like the star of 1866, it showed conspicuous in its spectrum the lines of hydrogen, together with other lines of uncertain origin. As its brightness decreased the hydrogen lines faded still more rapidly, leaving other lines more prominent, until, at last, the spectrum, instead of becoming that of an ordinary star, came to consist simply of three bright lines—the spectrum of a nebula—and it continues such to this day. Whether this is, or is not, the same spectrum it had before the outburst no one can say, as it had never been observed with the spectroscope before.

Now, I am very far from asserting that this was a case of collision; and yet it is clear enough that the whole course of phenomena was very much what might have been expected if it were. At any rate, the collision hypothesis is held and defended by several astronomers of authority, and the principal reason for preferring a different possible explanation lies in the fact that these "temporary stars," as they are called, are far too common to be probably due to stellar encounters. We have on record eight since the Christian era, and no less than three of them since 1840.

It is hardly necessary to say that if any retinue of planets attends such a star, its sudden blaze cannot fail to carry disaster and destruction to all life upon them. We can conceive that forms of life may be possible under almost any imaginable physical conditions, provided only the course of events by which they have been reached has been gradual enough to allow the necessary adaptations. One would not dare to deny the possibility of life of some kind on the airless moon, or even on the sun itself. But all we know makes it certain that no planetary life could survive the tremendous and catastrophic change of conditions involved in a sudden thousand-folk increase of the solar radiation.

Thus far we have been considering only collisions of stellar masses. But space is filled also with minor particles separated from each other only by intervals of a few hundred miles; and these, in the form of meteors and shooting-stars, are rushing through space, dropping continually upon the larger worlds, increasing their size, and adding to their store of heat and energy. Every year the earth encounters nearly three thousand millions of them, according to the estimate of Professor Newton, ranging from the merest particles to masses of several hundredweight. Very probably, also, the comets belong to the same category, being really nothing but larger meteors, or flocks of small meteors, or perhaps even only puffs of meteoric dust. Nearly all the meteors which strike the earth are very minute. Perhaps a hundred or so reach the ground each year as recognisable masses of stone or iron, weighing from an ounce or two to some hundreds of pounds, but all the rest are dissipated in the upper air, and never come down unless as impalpable dust, not to be certainly identified. The whole amount of matter falling daily upon the earth from outer space is probably about one hundred tons on the average (it is variously estimated from twenty-five to five hundred). A hundred tons is in itself a very considerable quantity, but utterly insignificant as compared with the mass of the earth, and entirely incapable of appreciable effect upon our temperature. Assuming even the largest estimate (five hundred tons a day), and also that the average velocity with which meteors enter our atmosphere is fifteen miles a second (probably considerably too large), we find that the heat annually received from them by the earth is only about fifty-three calories for each square mètre of her surface,—less than would be imparted by two minutes' perpendicular sunshine, and only about $\frac{1}{40,000}$ of the heat actually received from the sun in a year. Retaining the same extravagant estimate of 500 tons a day, it appears that the earth's diameter would grow an inch in about one hundred millions of years, and that her distance from the sun would be reduced about 83 feet in a million years, in consequence of the resistance experienced in moving through the meteoric swarms.

It would not, however, be just to the general reader to dismiss the subject without fair notice that some most eminent astronomers hold views at variance with those above expressed. The late Professor Peirce maintained to the end that the heat of the sun is chiefly due to the impact of meteors, and also that the earth itself receives as much heat from meteors as from the sun, a necessary result if the solar heat is really so produced. Of course, we have no space to discuss the matter here, and must be content with merely saying that the quantity of matter which falls upon the earth, if his idea is correct, ought to be easily noticeable, amounting to about 50 tons a day on each square mile. It involves also serious difficulties in the planetary theory.

So far as human beings are concerned, the most important question connected with our subject is whether anything is to be feared from comets, as a consequence either of collisions with the earth or of their fall into the sun. It may be said, just as of the stars before, first, that cometary collisions, either with sun or earth, must be very rare occurrences; and, secondly that they are practically certain to happen some time or other. Babinet computed, on the one hand, that a comet would strike the earth on the average about once in fifteen million years; on the other, we know at least three comets whose orbits cut the earth's path so closely that, if they should ever reach the crossing at the same time as the earth, a collision must occur. These comets are known as Biela's, Tempel's, followed by the Leonid meteors in its train, and the comet of 1862, which precedes the Perseids. One of the three, however (Biela's), has probably ceased to exist as a comet, and it is quite possible that the other two may vanish in the same way before we meet them.

As to cometary encounters with the sun, no comet has yet been known actually to strike the sun, but several have grazed very near it. The great comet of last year brushed through the corona, and came within three hundred thousand miles of the photosphere, and there is no assignable reason why some other comet should not actually pierce it.

As to the consequences of a comet's collision with the earth, it is impossible to predict them with scientific certainty; probably, however, they would be insignificant.

XUM

We know absolutely that the whole quantity of matter in a comet (technically, its "mass") is extremely small compared with that of the earth; but just how small no one can say. It is impossible to contradict authoritatively either the man who says he could carry a comet home in his pocket if properly packed, or one who asserts that a comet's nucleus is equivalent to an iron ball 100 miles in diameter. An attempt has been made to get at the density of the central nucleus on the assumption that it holds to itself the enormous volume of the head and envelopes by its gravitational attraction, as if the surrounding nebulosity were an atmosphere in equilibrium around the nucleus; but the assumption is more than doubtful, and the derived conclusion, of course, is of little value. It seems, on the whole, more probable that a comet is throughout only a cloud of dust and vapour—a mere smoke-wreath—than that there is at the centre any solid kernel of preponderant mass.

If a comet really has at the centre any great mass of stone or iron, or even a close-packed swarm of aërolites weighing a ton or two apiece, collision with it would of course be a most serious matter, spreading devastation and conflagration possibly over half the globe at once; not amounting, probably, to anything like a destruction of the world, but far more disastrous than any earthquake or volcanic eruption. It is far more likely, however, that the encounter with a comet would be entirely harmless—simply a most magnificent and brilliant shower of shooting-stars lasting for an hour or two—a phenomenon which one might well desire to see.

As for the effect of a collision between a comet and the sun, in respect to which there has been much disquieting speculation of late, the probability is that we on the earth should never know it, unless we happened to be expressly watching the event. For a few minutes, just as the nucleus was piercing the photosphere, there might be some unusual flash of brilliance and a fine outburst of solar prominences, followed, perhaps, and very probably, by intense magnetic and auroral disturbances on the earth; but the main thermal transformation of the impinging energy would be effected far below the visible surface of the sun, and would result merely in a slight expansion of its bulk, far too slight to be detected by terrestrial astronomers.

## THE AMATEUR ELECTRICIAN.

### BATTERIES VIII.

THERE is, perhaps, no greater fallacy than the idea that pervades large crowds of would-be inventors that a battery can in the matter of cost compete with a steam-engine as a source of energy. Of course, if we desire to ring a bell by electricity we should be mad were we to attempt it by means of a steam engine and dynamo, but we should be none the less fitting candidates for Hanwell were we to attempt to light the streets of London by means of any primary battery yet constructed. Nevertheless, there are many who have approached within a measurable distance such an aspiration. Most things in this world have a location or a function to which they are most advantageously adapted. To make them occupy any other position, or perform any other duty, is to more or less seriously handicap them in their struggle for existence. The electrical world knows no exception to this general rule. Where small quantities of energy are required, especially in out-of-the-way places, whether for bell-ringing, plating typing, telegraphy, &c., there is nothing to compare with the primary battery; but where large quantities of energy are required the battery should be at once relegated to the remotest distance as a thing to be shunned. The reason for this is not far to seek. The cost of producing energy by means of coal consumed in a steam-engine rapidly increases in proportion as we reduce the quantity of energy produced. Thus the proportionate cost of a one-horse-power engine is nearly, and often quite, three times as much as that of a ten-horse-power engine. For much less than a horse-power the cost (notwithstanding the relative cheapness of the fuel) and the trouble of maintenance increase out of all proportion, and an engine which would also be expensive to construct is therefore never used to produce such small quantities of energy. The advantages of batteries are that they are very cheap in construction, regular (within certain limits) in the amount of energy produced, capable of being fitted up in almost any place, and enable us by means of fixed wires to utilise the energy at places more or less remote from its source. Against these advantages there is to be considered the short duration of most forms of battery. When used extensively the cost of the zinc and chemicals is an important item. The energy evolved when a pound of zinc is consumed is about one-tenth of that resulting from the combustion of a like quantity of coal. A pound of zinc costs, say 4d., while a pound of coal costs but ·1d. (at 18s. 8d. per ton), consequently, to produce a horse-power by the combustion of zinc would cost, theoretically, 400 times as much as it would to produce the same energy by the combustion of coal, and we may safely maintain that no battery has yet been constructed which can be less than 50 times as costly as its competitor, and this only when a large allowance is made for more economical consumption in the battery than in the engine. A trifle may be regained by the sale of by-products, but it is only a small amount, and oftener than not quite negligible. It is, therefore, no wonder that the more prominent electricians and chemists have long regarded the utilisation of batteries for electric lighting as luxuriously extravagant. And this being the position taken by such men "it is hardly to be expected that men who, in some cases, are neither electricians nor chemists can hope to succeed." Where special circumstances exist, as for example in surgical or dental operations, in the sick-chamber, and for experimental purposes the battery may be more convenient.

We have been induced to say this much because undue prominence has lately been given to efforts which are being made in sundry places to introduce primary batteries as a source of energy for electric lighting. In one case, fifteen cells, which appeared to be modifications of the bichromate type, were used to illuminate twelve or fifteen five-candle-power lamps. The cost was stated to be a farthing per hour per lamp. This was apparently the estimated cost of the solution, but no account seems to have been taken of the zinc consumed. The chief merit in the battery referred to was its ingenious construction, affording as it did excellent facilities for charging and discharging. We cannot offer a definite opinion as to the relative value of the cell, as the constitution of the solution is kept secret. The plates are zinc and carbon, and the cell, if it has the durability claimed for it, may prove a good one.

Turning to the less ambitious forms, that known as the "granule" cell is a useful one. It is a compromise between the Leclanché and the bichromate. In an outer earthenware jar is placed a porous pot, the intervening space being occupied by a carbon plate and crushed (or granule) carbon, which together form a negative plate of unusually large surface. A zinc cylinder or rod is placed in the porous pot, which is then filled with a solution of sal-ammoniac. A solution

of bichromate of potash and hydrochloric acid occupies the outer cell, or the spaces between the pieces of carbon. The large forms generally have a tap at the bottom of the outer jar, to facilitate the removal of the spent bichromate solution. Such a cell, on account of the large amount of surface exposed, offers but very little internal resistance while the electromotive force of the cell is high—about two volts. The absence of acid in the porous pot implies an absence of local action, although that will only be a question of time, as sooner or later some of the acid solution in the outer jar will, by the ordinary laws of diffusion, find its way into the porous pot; even then, however, local action may be prevented if the influx of acid is not too rapid.

On reference to our description of the Leclanché cell, it will be seen that when the zinc enters into chemical action with the sal ammoniac ($NH_4Cl$), ammonia ($NH_3$) is set free, and is dissolved or absorbed by the water. Now, ammonia is a substance which has the power of neutralising acids; so that when the acid enters the porous pot it becomes neutralised before it reaches the zinc, and in that way prevents local action being set up. Polarisation, or the accumulation of bubbles of hydrogen, is to a great extent prevented, the large carbon-surface helping materially to bring about this result. Our experience of the cell, and the experience of many others, is that it is a good one.

## DOUBLE PERSONALITY.

A VERY remarkable case of double personality is described in a letter of Dr. Dufax to M. Azam. (*Revue Scientifique*, 1*st December*, 1883, *p.* 703.) He states that his *confrère*, Dr. Sirault, of Ouzin, had a young servant whom he often threw into a state of somnambulism. One day he was surprised to find this girl in the prison of Blois, where he was medical attendant. Upon inquiring he found she had left Dr. Sirault and entered the service of a lady, who accused her of theft. She protested her innocence with tears and sobs. Dr. Dufax thought her case might resemble that of his former patient, Mdlle. R. L., which he described in 1876 (*Rev. Sci.*), and who was in the habit of disposing of various objects during somnambulism, and supposing them lost when she woke up. On being asked whether she had such attacks in the prison the young girl knew nothing about it, but an attendant was able to inform the doctor that she rose every night, dressed herself, and walked round the dormitory. Having often seen M. Sirault send her to sleep by putting his hand on her forehead, Dr. Dufax operated in the same way, and then learnt from her, in reply to inquiries, that she had never thought of robbing her mistress, but considered some articles of value would be safer if placed in another cabinet. She intended to tell her mistress of their removal, but she forgot all about it in her waking condition, and never saw the lady in the somnambulic one. The doctor mentioned the circumstance to the *Juge d'Instruction*, who smiled incredulously, but permitted the girl to be taken to the lady's house where she immediately found and restored the missing objects. The girl was, of course, released, and the lady made what excuses she could for her hasty conduct.

THE TELEPHONE ON FRENCH RAILWAYS.—The French railway companies in general have decided to adopt the telephone as a warning apparatus, instead of the telegraph. The Western Company made this change some time ago, but the other companies have only now determined to follow its example.

## HOW TO MAKE USEFUL STAR MAPS.*

BY RICHARD A. PROCTOR.

THERE is no readier way of learning to know the stars than by occasionally mapping a constellation or a star-group, until one has filled a portfolio with useful sketches of the heavens. In well-constructed maps, on a large scale, and comprising but a small region of the heavens, we can mark in the place of any double star or other object of interest we may wish to examine, and so immediately learn whereabouts to look for it on the heavens. One cannot do this with ordinary star-atlases; because each map covers so large a part of the heavens that the scale must be small or else the maps unwieldy; while too often, from the same cause, the maps are in places so distorted that even if one marks in a star by the data given in the list of objects, one can yet form no clear notion of its position with respect to neighbouring objects. Besides, it is pleasant to have large-scale sketches of favourite groups or constellations. In such sketches one can do what is quite impossible in small-scale maps, viz., give to the large stars something like their true proportionate magnitude (magnitude being the only representative we have for brilliancy) without their covering a space as large perhaps relatively as four or five moons.

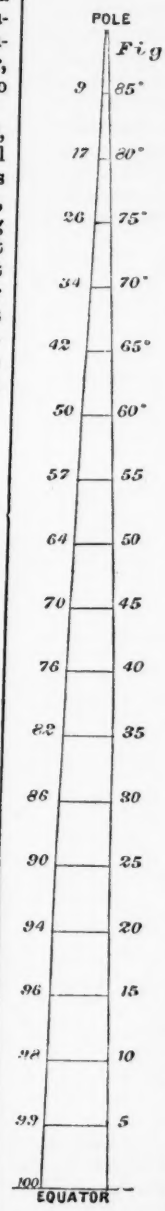


*Fig. 1.*

I propose to give some simple rules, by following which any one can lay down in a few minutes the meridians and parallels corresponding to any part of the heavens; afterwards filling in the stars at his leisure.

First we must consider the true shape of a strip of the globe, between the pole and the equator, and bounded by meridians five degrees (say) apart. This is shown in Fig. 1. We see that the bounding lines, though slightly curved in reality, may be looked upon as straight for any short portion of their length without introducing sensible error. It is on this fact that the mode of construction I am about to describe depends. If any portion of the strip represented in Fig. 1 had really straight edges, we could bring another similar portion alongside of it, without gaps or overlapping, another next to that, and so on, until we had space enough for a constellation or star-group belonging to that part of the globe. By *making* the sides straight, which we can do, as I have said, without appreciable error, we get such a space, the meridians and parallels of which are sensibly correct; and there is no accumulation of error as in other modes of mapping. Each space has the same error of shape that its next neighbour has—no more and no less.

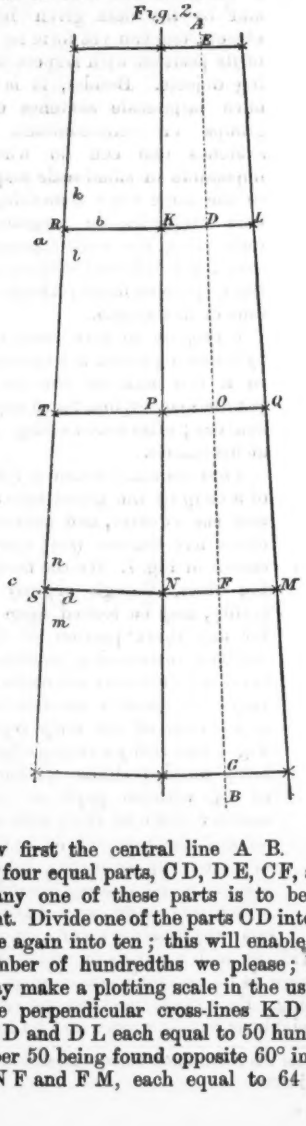
* Reprinted from the *British and Foreign Mechanic*, a long-since deceased weekly journal.

The numbers down the left side of Fig. 1 indicate the proportionate length of the cross-lines opposite them; the numbers down the right hand side indicate the distance from the equator in degrees.

Now suppose we wanted to make a map of a part of the sky the middle of which is 55° from the equator—there or thereabouts. And suppose further that the length of the region we wanted to map measures, from north to south, about 20°. Then the shape of a strip between two meridians, 5° apart, should be the same as the shape of the part of Fig. 1, between 45° and 65°. But we must straighten the sides. How can we do this with the least possible error? If we joined the ends of the cross-lines opposite 65° and 45° by straight lines we should have a small but still appreciable error; and so we should if we drew through the ends of the cross-line opposite 55° straight lines touching the curved boundary lines. We shall diminish the error to one-fourth, or make it practically inappreciable if, instead of either plan, we join the ends of the cross-lines opposite 40° and 60°.

Fig. 2 shows this done on an enlarged scale.

Fig. 2.




We draw first the central line A B. Along it we measure off four equal parts, C D, D E, C F, and F G. The length of any one of these parts is to be our basis of measurement. Divide one of the parts C D into ten parts, and one of these again into ten; this will enable us to measure off any number of hundredths we please; but those who prefer it may make a plotting scale in the usual way.

Draw the perpendicular cross-lines K D L and N F M, and take K D and D L each equal to 50 hundreths of D C, —the number 50 being found opposite 60° in Fig. 1. Similarly take N F and F M, each equal to 64 hundredths of D C, draw the lines K N and L M. These are two of our meridians.

Bisect K N in P, and take off parts equal to K P, or P N, along the produced line. Do the like with L M. The points obtained in this way belong to the parallels of our map. (It need hardly be said that if the range of the map is greater, the line we should get corresponding to K N would have to be divided into more than two parts).

Now notice that all we require further is to repeat the figure we have obtained as often as may be required to give the map the necessary breadth to include our star group. I give the geometrical construction for the purpose; but would advise the mappist to apply the much easier and more exact method given afterwards.

With K as centre and radius K L describe the arc $k\,l$; with N as centre and radius N M the arc $n\,m$; and with radius N L or K M, and centre successively at K and N describe the arcs $c\,d$ and $a\,b$. The points R and S thus obtained belong to the meridian next to K N: we join them, and divide as we divided K N and L M. Next on the side L M we repeat the process. Then on the side R S, and so on, on alternate sides, until we have as many meridians as we want. The construction has also given us the points along our parallels, and we can join these as shown in the figure. Our map is then ready for filling in the stars.

*(To be continued.)*

## EVIDENCES OF THE GLACIAL PERIOD.

*(Continued.)*

OUR last article on this subject was devoted entirely to the consideration of the inorganic evidences of the Glacial Period afforded by moraines, polished and striated rock surfaces, erratic blocks, perched boulders, scored and rounded mountains, and dome-shaped rocks; this article will be devoted, as promised, to the additional organic and collateral evidences of the same.

First as to the organic evidences.

In many parts of England are found sands and gravels, often at a considerable height above the sea-level, containing *sea* shells of an *Arctic* character. This, of course, is evidence that the land where such sands and gravels are found was once depressed beneath the sea-level, while the Arctic shells found therein show that the waters of the sea at that time possessed an Arctic temperature. These sands and gravels are called "glacial drift." They are found up to a considerable height on the Welsh mountains, and, wherever they contain sea shells of a kind now found only in Arctic regions, furnish conclusive evidence that the place where they are found must during some period have been submerged beneath the sea-level in an ocean of a very cold and Arctic nature—that is, during the glacial period. The occurrence of Arctic sea shells in this drift is, therefore, the chief point to be noticed under this head.

Of course, there are other sands and gravels besides those thrown down at the bottom of the sea. For example, there are "river gravels," formed by the action of rivers. Very often these "old river gravels," as they are called, are found near the banks of rivers, but high above the present level of the stream, the river having cut its bed deeper and left its old gravels, as its were, stranded. Very many of these old river deposits are found throughout England, and often constitute our present gravel-pits. This brings me to notice the bones and remains of animals which have been found so abundantly in these river gravels, the most im-

portant point in connection with such animals being that many of them were specially adapted to a severe and rigorous climate. For instance, the mammoth, a species of elephant, was covered all over with long, thick hair, evidently furnishing a very warm cover against the cold winters. We know that the mammoth was covered with this long, coarse hair, because the remains of one were discovered in Siberia which had been so well preserved in the ice that the hair was still intact; so that it is obvious that the mammoth was an animal specially suited for a very cold climate. Now, remains of the mammoth have been found in England in the greatest profusion; indeed, the tusks and teeth of this animal have been discovered in such plenty as to render impossible the slightest doubt that the mammoth once roamed over England in the greatest abundance. Such being the case, the evidence afforded by the remains of these huge animals, with their coarse, hairy covering, concerning the existence of a glacial period is very strong. Similar evidence is afforded by the remains of the hairy rhinoceros, woolly bear, &c., which abound in the old river gravels of England and the Continent.

Besides the old river gravels, so plentiful in our own land, many dried-up lakes are also to be found, especially in Yorkshire, between Bridlington and the Spurn Point, in the district known as Holderness. In these lake deposits are found the bones of extinct animals, notably those of the great extinct elk, a somewhat allied species to the existing reindeer. As everyone knows that reindeer now inhabit such cold countries as Norway, Lapland, &c., the inference afforded by these remains found in Yorkshire, Ireland, and elsewhere in favour of the existence of a glacial period is also very strong.

Besides river gravels and lake-deposits, a great number of caves are found in England and the Continent, in which caves have been discovered innumerable bones of the mammoth, hairy rhinoceros, woolly bear, reindeer, &c., &c. The presence of these remains in the English and Continental caves in such plenty plainly points to a time when the climate was more suited to those animals than at present. Such a time would be a glacial period such as we have already found good reason to believe actually occurred from our examination of several peculiar features in the scenery of the Northern Hemisphere generally. So that the organic evidences afforded by the remains of Arctic shells and the bones of Arctic animals furnish a valuable corroboration of the inorganic evidences afforded by moraines, polished and striated rock surfaces, erratic blocks, perched boulders, scored and rounded mountains, and dome-shaped rocks.

In addition, however, to the organic and inorganic evidences which we have seen unite to demonstrate the occurrence of a glacial period, we also find certain collateral evidences tending in the same direction. These collateral evidences are furnished chiefly by the facts connected with the geographical distribution of animals and plants, chiefly of plants, to which we will confine ourselves here. It is a well-known fact that the same plants occur on all, or nearly all, the mountain summits of Europe, no matter how widely these mountains may be separated from one another. How, then, have the same plants come to occupy stations so far apart? This question, so difficult to explain by any other means, becomes quite easy to answer on the assumption—supported by the other evidences we have mentioned—of the occurrence of a glacial period; for during such glacial period an Arctic fauna and flora would cover the whole of the lowlands of Europe north of the Alps and Pyrenees; but as the warmth gradually returned, the Arctic forms of life in the neighbourhood of mountains would gradually ascend such mountains higher and higher, while their brethren of the plains would at the same time be gradually driven northward by the returning warmth. Thus, when the warmth had fully returned, the same plants and animals which had during the glacial period lived together all over the European lowlands, would be found in the present Arctic regions of the North, and on many isolated mountain summits far distant from one another, just as we actually do find them at the present day. There are other facts in the geographical distribution of species which only the glacial period can explain; but the example given will be sufficient to show that the facts of such distribution point clearly to a glacial period as the cause of the present geographical distribution of species, particularly of plants in Europe.

We thus see that in addition to the inorganic and organic evidences which have led us to believe in the occurrence of a glacial period, the facts of the present distribution of species furnish strong evidence in the same direction, so that we have at least *three distinct lines of evidence all leading us up to the same conclusion.* These several evidences may for the sake of clearness be arranged in a tabular form, thus:—

I. INORGANIC EVIDENCES.

Moraines, polished and striated rock-surfaces, erratic blocks, perched boulders, scored and rounded mountains, and dome-shaped rocks, indicating ice-action.

II. ORGANIC EVIDENCES.

Remains of Arctic shells in drift.

Remains of Arctic animals in old river gravels, lake deposits, and caves, including those of the mammoth, hairy rhinoceros, woolly bear, reindeer, elk, &c.

III. COLLATERAL EVIDENCES.

The facts afforded by the present geographical distribution of species, especially of plants in Europe, &c.

It must be seen from the above that the belief in a glacial period is one supported by a strong chain of evidence—evidence, indeed, so strong as to render the occurrence of such a period not merely a matter of speculation or theory, but of established scientific proof. If the writer has succeeded in summarising these evidences so as to bring them home to any one not acquainted with the subject in a short and intelligible manner, his object will have been achieved.

## RECREATION IN SKILL.*

I NAMED a third chief element in recreations: the opportunities which they give for the exercise of skill in something which is different from our regular work. This may be in either mental or muscular work or both. One who has been all day busy in reading may refresh himself in composition; another turns from teaching to learning, and enjoys it the more for the contrast; another, most wisely, from the routine of business to some difficult research in science or in history; another from literature to music or the fine arts, whether in the practice or in the critical study of them. All these changes are the daily recreations of large numbers of the more cultivated classes; and they are matched in the instances of those who turn from their day's manual work, or the routine of life in offices or shops, to the mental work offered to them in colleges and evening classes. The labour of their study may be greater than that of their work; it may increase their fatigue; yet after sleep they may be conscious of an

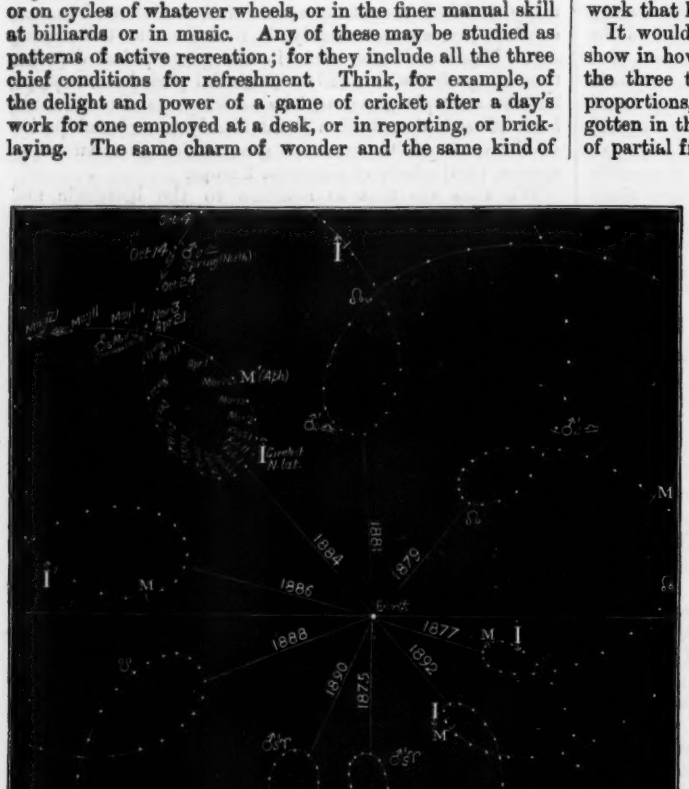
* From an article by Sir James Paget in the *Nineteenth Century*.

increased fitness for the business of their lives by reason not only of the knowledge they have acquired, but of their mental recreation.

But the most obvious examples of this part or method of recreation are in muscular exercises; in athletics; in the acquirement and exercise of skill in cricket or lawn-tennis, or on cycles of whatever wheels, or in the finer manual skill at billiards or in music. Any of these may be studied as patterns of active recreation; for they include all the three chief conditions for refreshment. Think, for example, of the delight and power of a game of cricket after a day's work for one employed at a desk, or in reporting, or bricklaying. The same charm of wonder and the same kind of contrast may be found in a thousand other instances. We enjoy the surprises of conjuring tricks, which to the conjuror himself, I suppose, give no stirring pleasure; and of fireworks, and the stories and actings of perilous adventures. More worthily we may enjoy and be refreshed by the marvels of skill in art, in music, or in singing.

When we listen to a long-sustained high note—such as Albani can sing or Joachim can play—we are refreshed not only by the beauty of the sound, but by the wonder that it can be produced, and it is this that most refreshes us when long afterwards we can recall the sound. It is the marvels of the ever-changing scenery, the decisive skill of the last climb, the final certainty, the awful beauty of the scene. Here is complete contrast with the routine life of the past months. He may never before have been so thoroughly tired, but next day he may be conscious that he never before was so thoroughly refreshed in both mind and body. After a vacation spent in pleasures such as these he may come home and rightly call himself "very fit" for the old work; he may even be so conscious of his fitness that he may enjoy the showing of it, and may love the work that he hated.

It would be easy, if it were not for their number, to show in how many of the most popular active recreations the three things which I have indicated are, in different proportions, combined. They may be overlooked or forgotten in the mere enjoyment of change, or of pleasure, or of partial freedom from responsibility; but there they are, and I believe that the happiness and utility of recreations may be nearly estimated by their amount: there are lives in the monotony of which they alone may sustain a good spirit of enterprise, of reverence, and of willing effort.




The path of Mars relatively to the earth during the opposition-period of 1884, with the corresponding loops for several past and future opposition-periods.

## THE PLANET MARS.

THIS planet is drawing nearer day by day and will continue to do so until Feb. 1, when it will be at its nearest. We shall show its course among the Zodiacal stars the week after next, giving next week that part of the Zodiac along which Jupiter is travelling, and the week following the next Zodiacal map in which the paths of Jupiter and Mars for the next two or three months will both be shown. The Zodiacal maps showing the sun's course in January and February will be given later, as the planetary paths require earlier delineation.

We give this week a picture showing the actual course, relatively to the earth, which Mars is at present pursuing; and for comparison the loops followed during several past approaches and to be followed at future returns of the planet. The picture explains itself.

The Foreign Trade of India in 1882-3.—The trade statistics of India during the official year 1882-3 reveal some very encouraging facts, which are rendered still more satisfactory by the increasingly favourable returns of India's foreign trade during the last five months. Another symptom of the increasing wealth of India is manifested in the import of gold. In 1878-9 there was as export of the precious metal of £896,173; but now, and for some years, there has been a steady and growing import of gold, and during the year under review the flow of gold into the country has risen to nearly five million sterling (£4,930,871). Of the entire trade that could have been conveyed that way, more than 86 per cent. passed through the Suez Canal, while 30 per cent. of the trade of India is with China, Australia, and other countries which cannot naturally avail themselves of the Suez Canal. During the last five months the wheat trade shows an increase in value of more than three millions sterling.

# THE UNIVERSE OF SUNS.

By RICHARD A. PROCTOR.

(*Continued from page 384, Vol. IV.*)

KEPLER'S quaint system described in the last number but one is illustrated in Fig. 1. Wright's may be regarded as in some sort illustrated by Fig. 2, only it must be understood that in this illustration the distances between the various galaxies are very much too small, or rather the galaxies themselves are on an enormously exaggerated scale as compared with the distances between them.

Five years later, Kant published his remarkable treatise "The Natural History and Theory of the Heavens." It was in this work that the philosopher of Königsburg predicted the discovery of planets exterior to Saturn. His ideas respecting the universe of stars were admittedly suggested by Wright's "Theory of the Universe" which he had read in a Hamburg journal of the year 1751, —though he is unable to indicate, he says, "to what extent his system is a reproduction or amplification of Wright's."

Passing over some remarks,—worthy of Kant's genius,—on the nature of the ideas we should form respecting the Creator and His Works, Kant proceeds to lay down the following theses :—

(1.) The stars,—not only those visible to the unaided eye, but all which the telescope reveals,—are suns, the centres of systems, as important as the solar system, and ruled like that system by gravitation.

(2.) But the action of gravity not only rules within such systems,—it extends from system to system. Thus all the stars are associated into a single system—the galaxy. They are in fact planets (that is, moving orbs) of a higher order.

(3.) As in the solar system there is a general level near to which all the planets travel, so in the system of stars we recognise a condensation towards a certain mean plane. This condensation explains the appearance of the Milky Way, which forms the Zodiac of the stellar system. All the stars travel on paths but slightly inclined to the mean plane of this stellar Zodiac, just as all the planets travel on paths but slightly inclined to the mean plane of the planetary Zodiac.

(4.) As the planets travel around a luminous central body it is probable that a vast luminous central orb exists round which the stars perform their circuits. Such an orb might be 1,000,000* times larger than our sun and yet if removed to a distance 100 times greater than that of Sirius (estimated on the supposition that Sirius is equal to the sun) this enormous orb would appear no larger than Sirius appears. In fact there are reasons for believing that Sirius is actually the central orb of the galaxy. For the Milky Way seems widest in the constellations of the Eagle the Fox and the Swan†, so that the sun must lie towards these constellations. Hence the central orb must lie in

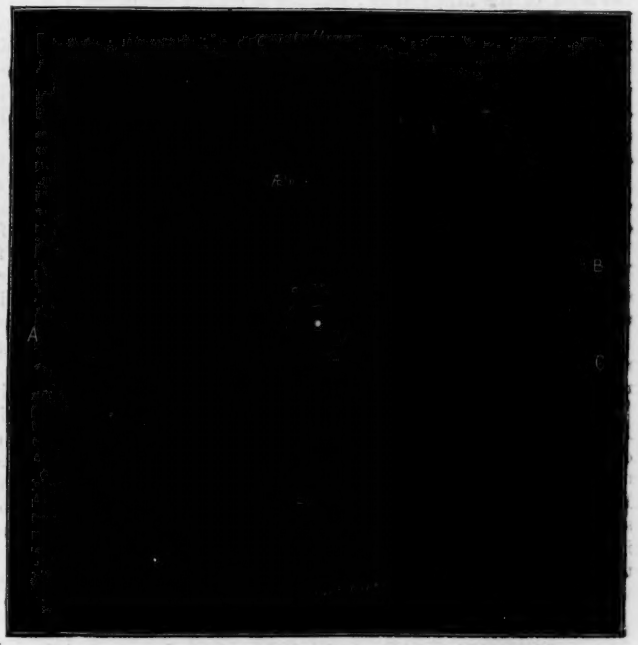



Fig. 1.—Kepler's Idea of the Universe (the Crystalline is shown in section only).

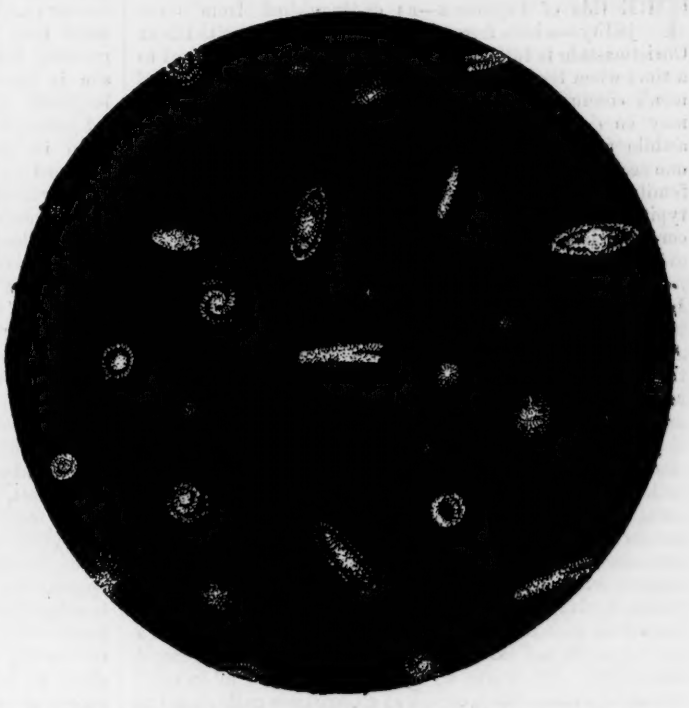


Fig. 2.—Illustrating Wright's Theory of the Galaxy and its Fellow Star Systems.

* Kant wrote 10,000,—which is, however, obviously erroneous.

† This argument fails in the presence of the actual fact—unknown to Kant—that the Milky Way is widest in Scorpio and the neighbouring constellations. Struve remarks well also, that the argument is only sound if the Milky Way is regarded as of the nature of a ring,—a theory which Kant does not appear to have entertained.

the part of the heavens directly opposite to these constellations. But Sirius is so placed, and as this star is the brightest in the heavens, we may infer that it is the central orb and rules by virtue of its superior size the motions of the rest. It is true that Sirius does not appear to lie in the level of the Milky Way; but this is readily explained by supposing that the sun is removed to some distance from this level.

(5.) The oval nebulæ which the telescope does not resolve into stars, are systems resembling the Milky Way, not only in general features, but also (as their elongated form indicates) in having a mean plane towards which their stars congregate.

(6.) The same sort of relation probably exists amongst the different Milky Ways which is recognised among the different suns of the Milky Way. These other Milky Ways are members of a new system of a yet higher order. We trace here the first terms of a series of worlds and systems, and these first terms of an infinite series enable us to infer the nature of the rest of the series.

It is scarcely necessary to point out how closely in many respects the ideas of Kant resemble those of Wright. It may, indeed, be said that Kant's theory only differs from Wright's in passing beyond the limits of observed facts. All Wright's theory, excepting his opinion respecting a central sun, was based upon observation, though in saying this I do not assert that all his inferences were just. Kant's conceptions respecting an infinite progression of systems, or rather of orders of systems, though undoubtedly imposing, cannot be regarded as involving any real addition to our knowledge.

*(To be continued.)*

## CHRISTMAS HAPPINESS.

BY THOMAS FOSTER.

THE tide of happiness—as distinguished from mere jollity—which flows over a part of our social life at Christmastide is full of hope to those who look forward to a time when the increase of happiness will be the guide of men's conduct at all times and seasons. One sees what may be done to make happiness greater when even for awhile men definitely set that object before them. And one sees also how that end is to be achieved. A sensible family group on Christmas day or at New Year's tide typifies not inaptly the human family as it might be if discordant elements were eliminated, whether by processes of evolution, by the influence of example, or (less hopefully, I fear) by the inculcation of sound and healthy philosophy. In such a group the object aimed at by all is that, for the time at any rate, all shall be as happy as possible. And where this object is definitely held in view the way of reaching it is not missed. No one seems to think he is going to add best to the happiness of those around him by subtracting from his own. He feels, even if he does not think it in any conscious way, that it is an essential part of the happiness of the rest that he also shall be happy, and something tells him (instinct or reason, who cares to decide?) that to be happy and cheerful he must be comfortable and contented. Directly as well as indirectly carelessness in this respect will diminish the comfort and content of the rest. There is plenty of room for self-sacrifice without wilful rejection of comfort; but apart from this, such neglect of self is annoying to others, sets a bad example, and leads presently to ill-temper and general discomfort. Of course a "wretch concentred all in self" would be a miserable presence at a Christmas gathering, but next to him in unpleasantness would be one who would insist on being uncomfortable, who would not take his share of pleasant things but looking askance at these as selfish indulgences for him, would make others feel that they also ought to go without their "cakes and ale" (by which, Oh sad Blue-ribbonist, I speak as in a figure, not necessarily including strong drinks, but typifying pleasant things in general). This would be bad enough even if the self-sacrificing one remained bright and cheerful to the end of the feast. But he would not. The same spirit which would make him refrain from enjoying pleasant things would probably from the beginning, but certainly ere long, make him refrain from saying or doing them.

But fortunately every sensible person at Christmas-time knows and feels all this. Even those who are untroubled by any fear of self-indulgence, whether in ways or in will, feel that their only course is to put aside their selfishness for the time,—and often enough (though Dickens rather exaggerated matters in this direction) they are surprised to find how much happiness to self may be derived from attention to the happiness of others.

Herein we see illustrated the doctrine for which the great teacher of our age has been so much abused, a doctrine readily pictured as mere selfishness, but in reality teaching that pure selfishness and pure self-abnegation alike diminish the happiness both of self and others, and inculcating care to increase the happiness of others, with due regard for the well-being of self,—for this reason, if for no other, that an ill-cared for self is a nuisance to all.

These points alone remain now to be considered in my discussion of the "Morality of Happiness,"—in two chapters on The Care of Self and Regard for Others.

## THE NEW YEAR.

EVEN in these advanced days men are but children. Else why should the return of the earth to a particular part of her path round the sun set them counting up what they have done since she was last there, or expressing hopes or wishes about what may happen before she is there again? Why should the earth's reaching longitude 100½ degrees from the first point of Aries set grown men at work either reckoning what they have done in the past, or else making fresh pavement for the road to Hades? We have all been acting as though some critical time had passed. Our papers have been full of summaries for 1883 which nobody has read, and of anticipations for 1884 in which no one believes. We have had the events of 1883 in the daily press, the art of 1883, the science of 1883, the literature of 1883 in *Academy*, *Athenæum*, art journals, and so forth; our *Graphics* and other illustrated papers have signalised this particular season with the love tales and ghost stories supposed to be appropriate to the dying out of the old year and the coming in of the new one; *Truth* has turned from customary self-contemplation in its mirror, to publish its Essence of Envy for 1883; our poorer public has gone through that British begging feat which makes us all so proud of our people on Boxing day, —and last, but by no means least, every one seems to have fallen into the pleasing belief (a very profitable one to some) that by clogging postal traffic with tons of painted cards, bearing for the most part idiotic mottoes, we best approve the love we bear to friends and kinsfolk. All this is delightful of course; but why just now? In what particular way does January 1 differ from December 31, that on one day we should all be looking backwards and on the other all looking forward,—and that this odd change of aspect should be made the occasion for so much that is childish and unmeaning?

## GAMBLING SUPERSTITIONS.*

BY RICHARD A. PROCTOR.

IT might be supposed that those who are most familiar with the actual results which present themselves in long series of chance-games would form the most correct views respecting the conditions on which such results depend—would be, in fact, freest from all superstitious ideas respecting chance or luck. The gambler who sees every system—his own infallible system included—foiled by the run of events, who witnesses the discomfiture of one gamester after another that for a time had seemed irresistibly lucky, and who can number by the hundred those who have been ruined by the love of play, might be expected to recognise the futility of all attempts to anticipate the results of chance combinations. It is, however, but too well known that the reverse is the case. The more familiar a man becomes with the multitude of such combinations, the more confi dently he believes in the possibility of foretelling—not, indeed, any special event, but the general run of several approaching events. There has never been a successful gambler who has not believed that his success (temporary though such success ever is, where games of pure chance are concerned) has been the result of skilful conduct on his own part; and there has never been a ruined gambler (though ruined gamblers are to be counted by thousands) who has not believed that when ruin overtook him he was on the very point of mastering the secret of success. It is this fatal confidence which gives to gambling its power of fascinating the lucky as well as the unlucky. The winner continues to tempt fortune, believing all the while that he is exerting some special aptitude for games of chance, until the inevitable change of luck arrives; and thereafter he continues to play, because he believes that his luck has only deserted him for a time, and must presently return. The unlucky gambler, on the contrary, regards his losses as sacrifices to ensure the ultimate success of his "system," and even when he has lost his all, continues firm in the belief that had he had more money to sacrifice he could have bound fortune to his side for ever.

I propose to consider some of the most common gambling superstitions—noting, at the same time, that like superstitions prevail respecting chance events (or what is called fortune) even among those who never gamble.

Houdin, in his interesting book, "Les Tricheries des Grecs devoilées," has given some amusing instances of the fruits of long gaming experience. "They are presented," says Steinmetz, from whose work, "The Gaming Table," I quote them, "as the axioms of a professional gambler and cheat." Thus we might expect that, however unsatisfactory to men of honest mind, they would at least savour of a certain sort of wisdom. Yet these axioms, the fruit of long study directed by self-interest, are all utterly untrustworthy.

"Every game of chance," says this authority, "presents two kinds of chances that are very distinct—namely, those relating to the person interested, that is the player; and those inherent in the combinations of the game." That is, we are to distinguish between the chances proper to the game, and those depending on the luck of the player. Proceeding to consider the chances proper to the game itself, our friendly cheat sums them all up in two rules. First: "Though chance can bring into the game all possible combinations, there are nevertheless certain limits at which it seems to stop: such, for instance, as a certain number turning up ten times in succession at roulette; this is possible, but it has never happened." Secondly: "In a game of chance, the oftener the same combination has occurred in succession, the nearer we are to the certainty that it will not recur at the next cast or turn up. This is the most elementary of the theories on probabilities; it is termed the *maturity of the chances*" (and he might have added that the belief in this elementary theory had ruined thousands). "Hence," he proceeds, "a player must come to the table not only 'in luck,' but he must not risk his money except at the instant prescribed by the rules of the maturity of the chances." Then follow the precepts for personal conduct:—"For gaming prefer roulette, because it presents several ways of staking your money—which permits the study of several. A player should approach the gaming-table perfectly calm and cool—just as a merchant or tradesman in treaty about any affair. If he gets into a passion it is all over with prudence, all over with good luck—for the demon of bad luck invariably pursues a passionate player. Every man who finds a pleasure in playing runs the risk of losing.* A prudent player, before undertaking anything, should put himself to the test to discover if he is 'in vein' or in luck. In all doubt he should abstain. There are several persons who are constantly pursued by bad luck: to such I say—*never play.* Stubbornness at play is ruin. Remember that Fortune does not like people to be overjoyed at her favours, and that she prepares bitter deceptions for the imprudent who are intoxicated by success. Lastly, before risking your money at play, study your 'vein,' and the different probabilities of the game—termed, as aforesaid, the maturity of the chances."

Before proceeding to exhibit the fallacy of the principles here enunciated—principles which have worked incalculable mischief—it may be well for us to sketch the history of the scamp who enunciated them—so far, at least, as his gambling successes are concerned. His first meeting with Houdin took place at a subscription ball, where he managed to fleece Houdin "and others to a considerable amount, contriving a dexterous escape when detected. Houdin afterwards fell in with him at Spa, where he found the gambler in the greatest poverty, and lent him a small sum—to practise his grand theories." This sum the gambler lost, and Houdin advised him "to take up a less dangerous occupation." It was on this occasion, it would seem, that the gambler revealed to Houdin the particulars recorded in his book. "A year afterwards Houdin unexpectedly fell in with him again; but this time the fellow was transformed into what is called a '*demi-millionaire*,' having succeeded to a large fortune on the death of his brother, who died intestate. According to Houdin, the following was the man's declaration at the auspicious meeting:—'I have,' he said, 'completely renounced gaming; I am rich enough; and care no longer for fortune. And yet,' he added proudly, 'if I now cared for the thing, how I could break those bloated banks in their pride, and what a glorious vengeance I could take of bad luck and its inflexible agents! But my heart is too full of my happiness to allow the smallest place for the desire of vengeance.'" Three years later he died; and Houdin informs us that he

* But a score or so of copies of the "Borderland of Science" remain now in stock, and it is not proposed to reprint that work, at least in its present form. But as the essays on "Gambling Superstitions," "Coincidences and Superstitions," and "Ghosts and Goblins," relate to subjects frequently discussed by correspondents, these will here be reprinted, as occasion serves. They supplement what has been said on these and kindred subjects in former numbers of KNOWLEDGE.

* This naïve admission would appear, as we shall presently see, to have been the fruit of genuine experience on our gambler's part: it only requires that, for the words "runs the risk," we should read "incurs the certainty" to be incontrovertible.

left the whole of his fortune to various charitable institutions, his career after his acquisition of wealth going far to demonstrate the justice of Becky Sharp's theory, that it is easy to be honest on five thousand a year.

It is remarkable that the principles enunciated above are not merely erroneous, but self-contradictory. Yet it is to be noticed that though they are presented as the outcome of a life of gambling experiences, they are in reality entertained by all gamblers, however limited their experience, as well as by many who are only prevented by the lack of opportunity from entering the dangerous path which has led so many to ruin. These contradictory superstitions may be called severally,—the gambler's belief in his own good luck, and his faith in the turn of luck. When he is considering his own fortune he does not hesitate to believe that on the whole the Fates will favour him, though this belief implies in reality the *persistence* of favourable conditions. On the contrary, when he is considering the fortunes of others who are successful in their play against him, he does not doubt that their good luck will presently desert them, that is, he believes in the *non-persistence* of favourable conditions in their case.

(*To be continued.*)

## Reviews.

### CENTRIFUGAL FORCE.*

By Richard A. Proctor.

I FANCY that the particular school of paradoxists believing in a flat earth is for a while tolerably well silenced. But there are other paradoxes not quite so preposterous which still remain to show how certain scientific matters, carelessly explained, cause doubt and difficulty in some minds, and excite in others the hope of acquiring fame before which the fame of Copernicus, Galileo, Kepler, and Newton shall wax pale and dim. Among the matters thus misunderstood, centrifugal force holds a leading place. The idea conveyed by the account of planetary motions given in certain old-fashioned books on astronomy, and repeated by some modern writers who ought to know better, is that a planet moves around the sun under the combined action of two forces—one the centripetal force tending towards the sun, the other the centrifugal force tending from the sun. The student imagines that in some unexplained way the centrifugal force waxes and wanes as the centripetal force does, so that the two remain constantly balanced; and presently finds himself perplexed by the thought that there is no obvious reason why the centrifugal force should thus vary. Nay, inquiring a little further, he begins to wonder what the centrifugal force is, whence it comes, why it acts always directly against the centripetal force. Further, since the planets in their courses are sometimes much nearer than at others to the sun, it seems obvious to superficial inquiry that having drawn them closer, and when they are closer having a greater pull on them, the sun should draw them in to his very surface. If in the game known as "the tug of war," one side had gained such an advantage over the other as to have already pulled it part of the way over the centre mark, and if, as the result of such partial success, the energy of their pull were increased, it would seem as though the contest were already decided: with part of its work already done, and with a gain of energy for the rest of the work, the side thus partially successful must presently complete its victory.

A paradoxist who not long since found foothold with his fardel of fallacies in the respectable pages of *Fraser's Magazine*, has recently been moved to publish a treatise calling attention to these difficulties. "What a scene of scientific confusion," he says, "is here presented to our view! When once gravity begins to overcome a rival force, its career of conquest cannot be arrested, except by the arrival and intervention of a third independent power, and the introduction of this third power is not properly and scientifically accounted for under the old system."

The truth really is, that the expression "centrifugal force," like the expression "force of inertia," belongs to an old system of nomenclature which implies more (according to our present usage) than it was really intended to signify. When Newton spoke of *Vis Inertiæ*, he did not mean any form of what we understand by "force." For by force we mean whatever causes a body to change its condition of rest or motion, whereas Newton's force of inertia meant that condition of rest or motion on which force acts to cause change. And in like manner with Newton's *Vis Centrifuga* or the Centrifugal Force of the olden writers. It is no force at all in our modern sense. It is not even properly called centrifugal, seeing that in many cases the tendency in question acts to bring a body nearer to the centre. For instance, when a planet is at the point midway in its elliptical path between the remotest and nearest points (meaning from the sun's centre) and is passing towards the latter, if suddenly the centrifugal force were to cease, the body would continue to move in a straight line, and for the first part of its motion in that straight line would draw nearer to the sun. In the case of a comet this would be still more marked. A comet of long period, returning towards the sun, has, throughout its course, up to the very point of nearest approach, a direction of motion which, quite apart from any pull by the sun, tends to carry it sunwards, and if the comet were left to itself when half-way back it would move for years in a course drawing it nearer to the sun.

If students of this subject would remember that instead of the centrifugal force which perplexed them in the old works, they have, in reality, to deal only with a particular case of what was of old called *Vis Inertiæ*, or force of inertness—no force at all, but a tendency to go on (if the body is already in motion) with unchanging velocity in a straight line, or to remain at rest if already at rest—the difficulty which Mr. Newton Crosland and others have found so perplexing will disappear. There is no contest between two rival forces (in the modern sense) when a planet pursues its constantly-curving path under the action of solar gravity. If the sun ceased to act, the planet would simply move on in the direction in which it was travelling at the moment when the sun's centrifugal force ceased its action. Those who imagine, again, that in such matters as the elliptic paths of planets and so forth the theory of gravitation encounters constant difficulties, and that, as Mr. Crosland suggests, these have to be met by shuffling and evasion, would do well to learn that the theory of gravity was established solely through its agreement with facts. Granted a force of given magnitude, residing in the sun's mass, and a planet moving at a given distance in a given direction (at the moment) and with a given velocity, the steady working of that force of attraction, according to the law of gravitation, on the planet, as it moves onwards, gives the observed elliptical orbit. Difficulties arose because of the disturbing influences of the planets on each other, of the earth on the moon and the

* This article, reprinted from the *Newcastle Weekly Chronicle*, may be regarded as a review of the "New Principia," by Mr. Newton Crosland. (Trübner & Co., London.)

moon on the earth, because, again, of the peculiarities of shape in the different planets, by which, though their orbital motion is not affected, their pose is disturbed, so that they reel like gigantic tops. But these difficulties have brought about some of the greatest triumphs which the Newtonian system has attained. Even where they have not been fully and successfully encountered, they in no sense affect the principles of Newtonian astronomy, any more than the practical difficulties which a surveyor may encounter (and by which he may perchance be foiled) invalidate the mathematical principles on which the surveyor's work proceeds.

## THE FACE OF THE SKY.

FROM JANUARY 4, TO JANUARY 18.

BY F.R.A.S.

SPOTS, &c., continue to diversify the sun's disc, which should hence be examined on every cloudless day. Map I. of the "Stars in their Seasons" represents the present aspect of the night sky. Minima of that remarkable variable star Algol in Perseus (same map) will occur at 1h. 35m. a.m., on the 11th; 10h. 24m. p.m. on the 13th; and 7h. 13m. p.m. on the 16th. Mercury is, for all practical purposes, invisible. Venus is very badly placed for the observer, but, as she sets after the sun, may possibly be caught with the naked eye, close to the horizon and over the S.W. by W. point of it. Seen in a telescope she is still gibbous, with a diameter of less than 12″, so that she is an uninteresting object. Mars is becoming more favourably placed for the observer every night. He rises a little before 7 o'clock to-night and very soon after 5 by the 24th. His apparent diameter increases from 15″·1 to-day to 16″·6 a fortnight hence, and his outline is very nearly circular. The polar snow and principal markings on his disc may now be very well seen with adequate optical power. Starting from a point to the right of the "Sickle," formed by $\alpha$ $\eta$ $\gamma$ and $\zeta$ Leonis ("The Stars in their Seasons," Map IV.) he travels backwards into Cancer. As Jupiter — speaking technically — comes into opposition to the sun at 3 a.m. on the 20th, he is now about as well placed for the observer as he possibly can be. Presenting a diameter of about 43″, he is a truly noble object even in a comparatively small telescope; and every increase of optical power reveals more and more curious detail on his surface. His path is a retrograde one in Cancer, to the right of the Præsepe (same map). The phenomena of his satellites observable before 1 a.m. are tolerably numerous during the next fourteen days. Beginning with to-night (4th), the shadow of Satellite II. will pass off Jupiter's disc at 8h. 19m., as will Satellite II. itself at 9h. 6m. p.m. On the 7th, Satellite I. will disappear in eclipse at 11h. 21m. 14s. On January 8 the shadow of Satellite I. will enter into Jupiter's face at 8h. 39m., followed by the satellite which casts it at 8h. 56m. p.m. Then at 10h. 31m. the ingress of the shadow of Satellite III. will occur. The shadow of Satellite I. will pass off at 10h. 59m., as will Satellite I. itself at 11h. 16m.; and at 11h. 37m. Satellite III. will follow its shadow on to the planet. On the 9th, Satellite I. will reappear from occultation at 8h. 23m., p.m. On the night of the 11th of January the shadow of Satellite II. will begin its passage across Jupiter's face at 8 o'clock, followed by Satellite II. itself at 8h. 25m. The shadow will leave the planet's opposite limb at 10h. 54m., and finally the Satellite will do the same thing at 11h. 19m. p.m. On the evening of the 13th, Satellite II. will reappear from occultation at 6h. 21m.; as will Satellite IV. the next night (the 14th) at 9h. 22m. The shadow of Satellite I. will enter on to the planet's limb at 10h. 33m. on the 15th, as will the Satellite which casts it six minutes later. Then at 12h. 53m. the shadow will leave Jupiter's face, followed by Satellite I. itself at 12h. 59m. p.m. On the 16th, Satellite I. will be eclipsed at 7h. 43m. 48s. p.m., will pass through the shadow behind Jupiter, and reappear from occultation at 10h. 6m. The shadow of this same Satellite (I.) will quit Jupiter's disc at 7h. 22m., on the 17th, followed by the Satellite only three minutes afterwards. On the 18th, the ingress of the shadow of Satellite II. will happen at 10h. 35m. p.m.; as will that of the Satellite at 10h. 38m. The egress of both will not happen until between 1 and 2 o'clock the next morning. Saturn may still be well seen through all the most convenient hours of the night; but, of course, the nearer he is to the meridian at the time of observation, the better. There is no sensible difference in the opening of his rings. He is still situated to the right of $\epsilon$ Tauri ("The Stars in their Seasons," Map I.). Uranus will scarcely come into view until next month; while Neptune should be looked for in Aries between seven and eight o'clock. Pons's Comet is travelling through Pegasus down into Pisces, and so towards Cetus ("The Stars in their Seasons," Map XII.). The moonlight will interfere considerably with its observation during the greater part of the time covered by these notes. The Moon's age at noon to-day is 6·0 days; and, quite obviously, it will be 20·0 days at the same hour on the 18th. She is fairly well placed for the observer during the first two-thirds of this time. Several occultations of stars will happen during our specified period. On Jan. 6, the sixth mag. star 54 Ceti will disappear at the Moon's dark limb at 8h. 15m. p.m., at an angle of 157° from her vertex, to reappear at her bright limb at 9h. 18m. p.m., at a vertical angle of 291°. Two sixth magnitude stars will be occulted on the 8th. The first is B. A. C. 1119, which will disappear at the dark limb at 3h. 44m. p.m., at a vertical angle of 73°, and reappear at her bright limb, at an angle of 239° from her vertex at 4h. 44m. p.m. The second star occulted is B. A. C. 1206, which will disappear at the dark limb at 10 h. 50 m. p.m. at an angle from the Moon's vertex of 160°, reappearing at the bright limb at an angle of 280 from her vertex at 11h. 48m. p.m. On the 11th, 26 Geminorum, a 5½ magnitude star, will disappear at 3h. 37m. p.m. at the dark limb, at a vertical angle of 58°, reappearing from behind the bright limb at 4h. 26m. p.m. at a vertical angle of 228°. Before the Moon rises on the 13th she will have occulted the 6th magnitude star $A^1$ Cancri; this will reappear at her dark limb at 6h. 12 m. p.m. at an angle of 158° from her vertex. Afterwards, at 7 h. 20 m. p.m., $A^2$ Cancri, another star of the 6th magnitude, will disappear at the bright limb of the Moon at an angle of 5° from her vertex, to reappear at her dark limb at 8h. 9m. p.m., at a vertical angle of 253°. Thirdly, on the same night 60 Cancri, a 6th mag. star, will disappear at the bright limb at 11h. 55m. p.m., at an angle of 41°. from the vertex of the moon. It will not reappear at the dark limb until eight minutes past 1 o'clock on the following morning, its emersion occurring at a vertical angle of 259°. At noon to-day the moon is a little to the S.E. of $\lambda$ Piscium. She is travelling through Pisces until between 7 and 8 p.m. on the 6th, when she enters Aries. It occupies her until 11 a.m. on the 8th to cross this constellation; and at the hour last named she passes into Taurus. She is traversing Taurus until 9 p.m. on the 10th, when she quits it for the extreme northern part of Orion, her passage over which takes her twelve hours to accomplish, after the lapse of which time she emerges into Gemini. Across this she travels until 10 p.m. on the 12th, when she enters Cancer, which she quits at noon on the 14th for Leo. At 1 p.m. on the 15th she descends into Sextans, re-emerging into Leo between 5 and 6 a.m. on the 16th. At 8 a.m. on the 17th she quits Leo for Virgo. She is still in Virgo when our notes terminate.

A COMPLIMENT TO THE BRUSH ELECTRIC COMPANY.—The Emperor of Brazil has presented to this company a large artificial flowering plant, made entirely of the feathers of South American birds, as a token of his gratification at the completing of a very successful system of electric lighting in the city of Campos, Brazil.—*Engineering.*

DANGERS OF OVERHEAD WIRES.—The following is taken from the *New York Nation*:—"After the experience in Fifth Avenue, on Monday evening, there is no necessity for further expert testimony concerning the danger from electric lighting wires. A runaway in the Avenue broke down one of the electric lamp-poles, and trailed the wire upon the pavement. A passing horse stepped upon the wire; there was a flash of purple light, a report like a pistol-shot, all the lights in the Avenue went out, and the horse fell dead. A moment later another horse stepped upon the wire and dropped dead, like the first. The Avenue was immediately closed to travellers of all kinds. Of course, if a person had stepped upon the wire, he would have shared the fate of the horses. It was a stormy night, and there were few people upon the Avenue, or the consequences might have been much more serious. A wire which kills instantly every person who treads upon it, would be a deadly thing for a crowd to surge over. Clearly the only safe place for these wires is under ground, and the sooner they are put there the better."

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

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## VARIABLE AND RED STARS IN CYGNUS—DOUBLE STARS IN TAURUS AND ORION—SATURN—PONS-BROOKS' COMET—THE REMARKABLE SUNSETS.

[1077]—The constellation Cygnus is conveniently situated for telescopic observation during the early winter months, and it affords a rich treat to sweep with a low power its magnificent fields, the milky way, with its star-dust and innumerable specks of light, forming a beautiful background to the lucid stars of this asterism, and presenting some wonderful configurations, with which the eye is never wearied. Cygnus is noted for its variable stars, and also so-called new stars; the first observed in 1600 by Kepler and others; the second, in 1686, by Kirch, in the neck of the Swan. More recently, Schmidt's Nova, discovered 1876, Nov. 24, when it blazed to 3 magnitude. In October, 1877, it had faded to 10½ magnitude. In October, 1878, still further down to 14 magnitude. In October, 1881, it had dwindled to 16 magnitude, when I last examined it, and is now only visible in the largest telescopes.

Mr. Birmingham, of Millbrook, Tuam, well known as the discoverer of many red and variable stars, found 1881, May 22, a deep red or crimson star in R. A. 20h. 37m.; D + 47° 42′ ±, or about 2° 51′·7 north of *a* Cygni. It was then about 9 magnitude, being near one of its maxima. It appears to change from about 8½ to below 12 magnitude. Its period is probably over twelve months; but I am not aware whether this has been yet determined. Its colour is very intense, being obvious when even near its minimum. There is a minute *comes* about 60″ north of it.

Observers interested in unequal double stars will find one about 3′ preceding the above variable star. The pair lie about 7′ north of Σ 2707 (a triple star, or rather quintuple, for there are two 11-12 magnitude stars *n.f.* which make up a peculiar curved group), which point to the pair to which I refer. The magnitudes are about 6 and 12; P 200°±; D 7″±. The principal star is preceded by a string of 10 to 12 magnitude stars forming a sinuous curve winding round to the north. I believe this pair will be found to be a test for a 5-inch telescope.

There is another unequal double star in Taurus in R. A. 4h. 24m. 40s.; D + 14° 25′ 30″. It is marked "A" in diagram (Fig. 1). The star "C" has also a faint *comes n.f.* at 20″±. The *comes* to "A" is closer, being 12″± at 70°± P angle. It lies 1° 13′ south of, and about 3m. following 9′ Tauri. A 5-inch telescope should show the comites of both A and C.

Those observers with telescopes of 8 inches to 10 inches aperture, who would wish to test the light-grasping power of their instruments, might try a faint double star which I picked up in November, 1878, in the field with ι (Iota) Orionis in R.A. 5h. 30m.; D − 5° 59′. It was measured by Dr. Copeland on January 15, 1879, mag. 11·2 and 13·4; P. 288°·4; D. 10″·8. By some mistake these measures were appended in Webb's "Cel. Objects," 4th Edition, p. 361, to OΣ 98 (14, alias ι), instead of following Iota Orionis (Σ 752) on p. 359, where the pair is only mentioned. The diagram of the field (Fig. 2) will assist in identifying the double which is marked "A," the triple star Iota being south of it, with a 9½ magnitude star between them, and north of it about 30″ is a 9¾ magnitude star.

The great northern declination of Saturn during the present opposition renders it favourable for observation. On Dec. 9, at 10.30 p.m., the definition was superb, and the image of the planet with the 4·3 inch refractor, and a power of 113, was like a line engraving. The "crape ring" was visible in the ansæ, with this low power, in the moonlight. The boundary between the bright equatorial region and the darker southern portion of the ball was distinctly marked by a dark *streak*, which appeared to be *beaded*, but my intention to employ a higher power was interrupted by having to turn to another object.

The Pons-Brooks comet has been visible to the naked eye for the past three weeks, and has now travelled into Cygnus. When I first saw it with the 4·3-inch refractor on Sept. 10, it presented a very faint and diffused nebulous mass without a trace of nucleus. It was not found in the low-power field of the place indicated in the first rough ephemeris, and might readily have been overlooked at that time, in the light of the young moon, with even ten inches of aperture. On Sept. 22 and 25 it showed signs of condensation towards the centre. On Oct. 1 it had brightened, so that it was easily seen with a 2¾-inch O.G. of 36 inches focus, and a terrestrial eyepiece of about 50 power. During the middle of November an incipient tail developed on the *n.f.* side, though very narrow and faint compared with the large coma surrounding the nucleus, but the nebulosity of the coma appeared to extend farther in the direction of P. angle 150°, the tail lying in about 60° P. angle. Any apparent fluctuations in brightness during the end of September I attributed to slight haze, invisible to the eye, though observations elsewhere would seem to point to other primary causes.

The remarkable sunsets and sunrises which have been seen over the greater part of the earth (though, by the way, I have not any mention of it from the United States) were first noticed here on Nov. 25, and on several occasions since when the sun set in the ordinary clear sky. The upper glow seemed to be from very high strata, lying fair above the level of the highest cirrus clouds, and if it be cosmic or volcanic dust which reflects this glow it must be far above the ordinary height of snow or rain clouds; and, therefore, the experiment suggested by Mr. A. C. Ranyard in your paper would scarcely be conclusive, even if undertaken with all the care with which it appears to have bestowed upon it in the interesting observations of Captain Noble and Mr. M. Mattieu Williams.

I would rather incline to accept the theory that the dust is terrestrial, and not cosmical, because in the latter case its effects would most likely be observed simultaneously over the earth, whilst dust from the tremendous eruption of Krakatoa would take some time to travel to the opposite hemisphere. I refer to the *finer* dust traversing the region *above* the ordinary surface currents, and not to the heavier and grosser matter which appears to have been carried in one instance 970 miles in about forty hours, in a westerly direction; and in another case about 1,050 miles in a south-south-easterly direction in about seventy hours.

Might not the enormous quantity of mixed gases of a light specific gravity, which must have been ejected to a tremendous height, and carried with them a great mass of the finer impalpable dust, have floated, as it were, with some higher universal currents (of which we know very little), and carried slowly above the surface winds, though not necessarily in a uniform stratum over the earth?

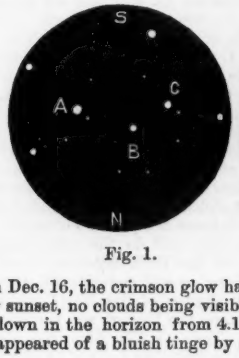



Fig. 1.

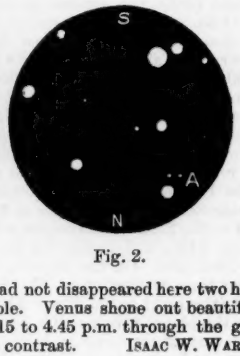



Fig. 2.

On Dec. 16, the crimson glow had not disappeared here two hours after sunset, no clouds being visible. Venus shone out beautifully low down in the horizon from 4.15 to 4.45 p.m. through the glow, and appeared of a bluish tinge by contrast. ISAAC W. WARD.

## THE AFTERGLOW.

[1078]—Did any one of my fellow-readers of KNOWLEDGE witness the sunset on Christmas Day? I ask, because here, in Sussex, the dense pall of fog which obscured everything turned of a distinct crimson at and after the time at which the visible sun would have been setting, and long after dark the fog was markedly red. This last effect was very weird and uncanny. I can only imagine that the afterglow must have been vivid in the extreme to have penetrated such dense mist as blotted out our Christmas landscape here. WILLIAM NOBLE.

Forest Lodge, Maresfield, Uckfield, Dec. 28, 1883.

### THE COLLECTION OF DUST FROM SNOW.

[1079]—I hope that if another fall of snow should occur, several of your readers will collect and examine the dust brought down by the snow-flakes. Clean snow should be collected as soon as possible after its fall. No doubt the first flakes that come down bring with them more atmospheric particles than those which fall subsequently; but as these fall upon the ground, it will be well to leave them and collect only the surface snow, which may be cut off with a clean piece of glass. The snow should be collected in a bath or large earthenware pan, which for the sake of precaution should be first rinsed out with water. As much snow as possible should be collected, as experimenters will probably be disappointed with the amount of water they obtain, and also, if the collection is carefully made, with the small quantity of solid matter which it contains.

The best way of collecting the solid particles is by allowing them to settle in a tall vessel. The surface water should then be carefully drawn off, and the remainder should again be allowed to settle in a smaller vessel, such as a test-tube. Ultimately, the remaining water should be evaporated at a low heat, so as to avoid boiling. This method of collecting the particles from the water is preferable to filtering, even with Swedish filter-paper—and blowing away the ashes of the paper after burning, as changes in the dust due to heat are thus avoided. I am anxious to examine the matter brought down by snow, so as to eliminate with greater certainty the terrestrial matter collected from the lower air. I hope shortly to give an account of the snow residues and Krakatoa dust which various friends and correspondents have kindly sent me.

Lincoln's Inn. A. C. RANYARD.

### RED SKIES IN AMERICA.

[1080]—I am glad to see the article upon "Extraordinary Sunsets" in the last number of KNOWLEDGE, just received. It seems strange to me, however, that no accounts of the phenomenon have yet reached you from this side; but I suppose you will have plenty of them in due time. Seeing the request of Mr. Ranyard for particulars, I thought I would send you a few points, and hope that some of you will be able to explain this knotty subject, as it seems to be a puzzle to our scientists upon this side. My attention was first called to the matter about the latter part of November—somewhere about the 20th, I think. I was in the office, when one of the clerks came in and said that there "was a tremendous fire somewhere up town." I at once went out, and saw the whole western heavens illuminated. The sight was such a strange one that we went on top of the building, and it was at once evident that it was no fire. As near as I can recollect the "red glare" extended for upwards of 40° from the horizon, and for 60° or so along it. All the large buildings, steeples, &c., of the city stood out clear and distinct upon the bright background of the sky, as if lit up by some immense conflagration. This was about six o'clock in the evening. A little before seven o'clock the phenomenon had pretty well disappeared. People in the streets were watching it, and wondering what was the matter in the sky.

One old "darkie" whom I first asked upon coming out of the office where the fire was, answered: "Dat's no fire, mister, dat's de elements; de world must be coming to an end." The general impression among the masses seemed to be that something was wrong in the sky.

I have not much of an eye for colour, but to me it appeared fiery red, without any green whatever. The next day I saw in the papers that one of the fire departments in a Northern city had been called out by mistake, having taken this "red glare" to be an immense fire.

This strange light has been hanging around the sun, more or less, ever since, although to me the phenomenon has never been as marked as upon that occasion. The past three or four days have been cloudy, with occasional snow (the first snow of the season), and as it is now clearing up, I shall watch this evening to see if the snow-fall has had any effect upon this strange light, as suggested by Mr. Ranyard.

I enclose one of our papers, giving a general account of the phenomenon, with the various theories advanced here, to account for it.

Can you not take up this matter, and see if a satisfactory explanation cannot be given? It seems difficult to believe it merely atmospheric, as the phenomonon was such a general one.

Baltimore, U.S. W. H. NUMSEN.

### LETTERS RECEIVED (SUB-EDITOR).

ROSE.—LATIMER CLARKE.—W. HUME.—F. W. W.—F. C. H.—J. THOMPSON.—T. COOP. Effect due to irradiation.—E. GRAY. Webb's "Celestial Objects."—J. MURRAY. It is so; but Mr. Proctor did not wish to hurt your feelings by saying so.—A LADY MATHEMATICIAN. Thanks; but of course not forwarded to Editor—seems so childish, you know.—RICHARD ROTH.—IGNORS. May be obtained from them, but is not present as alcohol.—D. C. Many thanks on the Editor's behalf, and good wishes heartily reciprocated.—J. C. FLEWETT. SUFFERER wishes to know where and how distilled water can be obtained. COSMOPOLITAN—J. H. DAVIS—J. H. BRIDGER—C. DE G.—SELLS. The Editor's "Universe of Stars," close of last essay.—ELMIN—J. K. N. Mr. Ranyard has promised a paper on this subject.—C. A. E. It is proposed to have some papers on physics (to begin shortly), and that difficulty will be considered among others; but is it clear you can locate a sound, when one ear closed, and sound not of known nature and origin?—W. R. No truth whatever in the theory of Mr. Jenkins.

## Our Chess Column.

By MEPHISTO.

### THE BOOK OF THE TOURNAMENT.

(*Conclusion.*)

THE Irregular Opening which, next to the Ruy Lopez, played the most important part in the opening *debuts* of the tournament, is not dealt with in a satisfactory manner by the masters, either in their actual play or in analysis. It is an unsatisfactory feature in the analysis of first rates that they quite ignore the student who wishes to benefit by their experience in the openings. In looking through the notes we only find two general references in regard to the well-known position arising from the development of P to Q4, QB4, Kt3, and K3, with the B on Kt2, and K2, or Q3, Kt on Q, and KB3, and Castles for both players. Zukertort says:—"Early exchanges of the centre Pawns in all close openings of this sort, whether made by the first or second player, are not advantageous. It would be impossible (?) to frame a strict rule on the point—in fact, the delicate handling of Pawns and other developing movements in close openings must entirely depend upon the judgment of the player; but, *cæteris paribus*, the game should be fully developed on both wings before entering on any direct line of action." This is correct enough in a general sense, but we think the defence ought always to limit itself to the position given above, and no other. It is a curious point that in none of Zukertort's games was this position attained. The memorable game between Zukertort and Blackburne was likewise an Irregular opening, but Blackburne placed his Kt on Q2. We take this opportunity to express our disapproval of the various personal references, and between line readings contained in the book. Chess analysis should, as far as possible, stand on its merits. Steinitz comes in for a good deal of this sort of thing. We all remember that Steinitz repeatedly and strongly condemned the move of P to QR3 which Zukertort considered necessary, and played in his match against Blackburne, only to desist on his defeat by the latter player at Berlin. Steinitz likewise pointed out that the defence should adopt the line of play indicated above. Several writers on openings take the same view, but, with more discretion than courage, they do not follow the position up. We hope to treat on this opening in course of time.

On the whole, the book will prove an inexhaustible source of pleasure to every Chess player, and remain a standard work, as far as the games are concerned, for all times. The Editor tells us in his preface that he did not intend to furnish all the games with profound notes. It would be an interesting work to arrange a separate small volume dealing analytically with the openings of the games only.

### PROBLEM No. 110.

By HENRY BRISTOW, p. 382.

POSITION.

White.—K, K6; R's, KB3, K7; B's, KKt4, QKt6; Kt, QKt3; P's, KKt3, Q5, QB2, 4.

Black.—K, K5; R, Q5; B, K sq; Kt, Q8; P's, KKt2, 4, Q3, QB2, 6, Kt2.

Solution—1. R to B sq.

If 1. P takes B. 2. K takes P, mate. If 1. K to K6. 2. K to B5, mate. If 1. R to Q6. 2. B to B5, mate. 1. Kt to B7 or Kt7. 2. R to Ksq. 1. Kt to K6. 2. B to B3. If 1. P to Kt3. 2. K to B3, mate. 1. B moves. 2. K moves, and mates acordingly.

*In consequence of the great pressure on our space the "Answers to Correspondents" are unavoidably held over.*

## Our Whist Column.

By "Five of Clubs."

The following game is taken from an old number of the *Westminster Papers*. It illustrates the important principle that the first thought of the weaker hands should be to save the game.

The Hands.

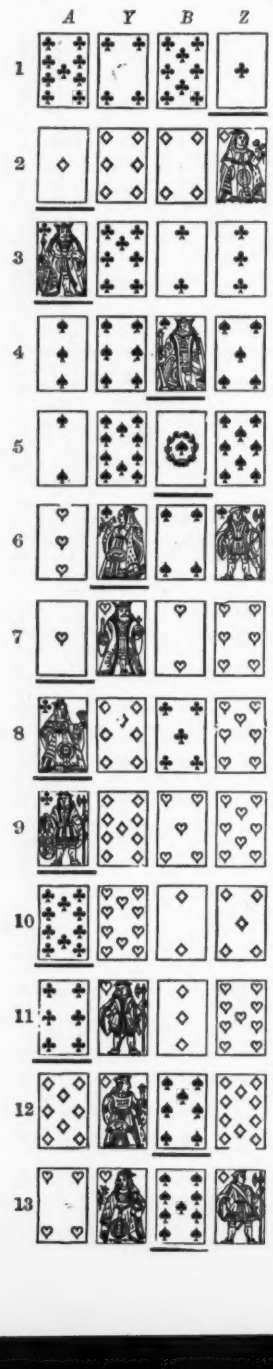
*A.*
*Spades*—3, 2.
Hearts—A, 4, 3.
Clubs—K, Q, Kn, 10, 9, 6.
Diamonds—8.

*B.*
*Spades*—A, K, 9, 7, 4.
Hearts—5, 2.
Clubs—8, 5, 2.
Diamonds—4, 3, 2.

Y B
Score—
Love all.
Dealer.
A Z
*Trump S.*Kn.

*Y.*
*Spades*—Q, 10, 6.
Hearts—K, Q, Kn, 10
Clubs—7, 4.
Diamonds—K, 9, 7, 6.

*Z.*
*Spades*—Kn, 8, 5.
Hearts—9, 8, 7, 6.
Clubs—A, 3.
Diamonds—Q, Kn, 10, 5.




Note.—The card underlined wins the trick, and card below leads next round.

Notes and Inferences.

1. *A* leads from the lowest of his long head sequence, that *B* may play the Ace if he has it, and so get out of the way. *B* begins a signal. It is true he has no strength outside trumps, but *A*'s lead implies great strength in Clubs. As original leader *A* would not lead the best of a short suit, and whether the Nine is the lowest of four-card suit, or the penultimate, *A*'s Club suit must be very strong. *Z* has nothing between Eight and Ace.

2. *B* again begins a signal.

3. The signal is completed. *B* having, for reasons not obvious, signalled with the Eight instead of the Five, *A* might infer that *Z* holds the Five, and that therefore he cannot be led to in Clubs by his partner. *Y* would form the same inference, for it is clear to all that *A* led from a Quint to King, and the Six of Clubs ought not to be with *B*.

6. The two remaining trumps are with *B*. Theoretically *A* should have discarded a Diamond; but it is not a matter of much importance. For if *A* gets a lead he must make all his Clubs, and *B* the remaining tricks with trumps.

7. *Y* fal's into a fatal error. A single trick will save the game, and a single trick in Diamonds is almost certain, while probably two may be made. On the contrary, if *A* holds the Ace of Hearts, *A* and *B* are bound to win.

8 to 13. *A* makes all his Clubs, *B* the two remaining tricks with his trumps, and *A B* make five by tricks.

Note on *Y*'s Play at Trick 7.—*Y* knows that four winning Clubs are with *A*; two long trumps with *B*; Knave, Ten, and another Diamond (at least) with *Z*. He has reason to think that *B* has no Club, and that (from his discard) *A* either has two Diamonds or none; also, perhaps, that Heart Ace is with *B*, unless *B* signalled with absolutely no strength outside trumps. In any case if *B* holds but one Diamond, leading Diamond King saves the game; whereas if *A* holds Heart Ace laading a Heart is the one (apparently) sole way of losing it. Had *B* no Club, it would still have been wrong to lead Hearts.

The first two lectures of Dr. Andrew Wilson's course on Anatomy and Physiology were given in Prince's Hall, Piccadilly, London, W., on the evenings of Thursday, Dec. 27, and Monday, Dec. 31. The lectures were well attended. The subject of the first lecture was "The Skeleton;" the second night's subject being "How we Move." Lime light illustrations were used throughout the lectures, the beautiful diagrams and views eliciting the admiration of the large audiences; while the fluency of the lecturer, his well-known facility of illustration, and his complete grasp of his subject, together contributed to make each evening's lecture at once an enjoyable recreation and an intellectual treat of no mean order. In dealing with "The Skeleton," Dr. Wilson built up his discourse largely from the standpoint of comparative anatomy; and showed the community of type which exists between the human and all other vertebrate forms. Spine, skull, trunk, and limbs were successively passed in review and duly illustrated; while the microscopic structure of bone, its growth, and its repair by the periosteum or bone-sheath were noticed at the close of the first lecture. In his second discourse, Dr. Wilson, again starting from lower life, showed how all forms of movement in animals might be regarded as due to the contractility of protoplasm or of its elaborated representatives. Joints and muscles were duly passed in review, and the movements of plants were also noted. The curious little *cilia*, by means of which animalcules move, and which exist in the human lungs, windpipe, and other situations, were described at length. By means of these protoplasm filaments currents in air or in fluids are created, and various movements executed. The remaining lectures by Dr. Wilson fall to be delivered on the evenings of Thursday, Jan. 3, and Saturday, Jan. 5, 1884. No more instructive lectures on subjects connected with the structure and functions of living beings have been delivered, and we hope to hear of the extension of Dr. Wilson's labours to the southern provinces in continuation of his Scottish work.

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